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DESCRIPTION

MANIPULATOR-TYPE ROBOT

TECHNICAL FIELD

The present invention relates to a connection with use of a connector between a manipulator of a manipulator-type industrial robot and an external device.

BACKGROUND ART

A manipulator-type industrial robot (hereinafter referred to as a robot) generally contains electric cables, fluid pipes for supplying air or gas, and the like. These cables and pipes are used in a motor driving joint axes of a manipulator, a welding feeder device mounted on the manipulator, and peripheral devices, such as various kinds of sensors and a handling holder device.

The electric cables are connected to control devices or external devices such as welding power supply at a connector or a cable opening disposed in a connection case of a manipulator base section. Specifications for, and the number of the signal lines of the electric cables that connect between the manipulator and the control devices are determined by a motor that drives joint axes of the manipulator. On the other hand, the signal lines of the electric cables that connect the manipulator to the external devices including welding power supply vary in specifications and quantity because peripheral devices to be mounted on the manipulator depend on the use of the robot.

The cables routed through inside the manipulator undergo bend or torsion caused by rotating motions of the joints of the manipulator. The need

of mechanical durability imposes limitation on the signal lines in specifications and quantity. In other words, due to the limitation, the cables routed inside the manipulator cannot be simply increased in diameter sizes or quantity.

As for cable connection at a connection case of a manipulator, a method in which a split connector is used for one frame, as shown in Fig. 9A and Fig. 9B, is conventionally known. The method, for example, is disclosed in Japanese Patent Unexamined Publication No. H11-129185.

Fig. 9A is a section view illustrating the essential part in the interior of the connection case of a conventional robot. Fig. 9B is a section view of a conventional split connector shown in Fig. 9A. Internal cable 108 is inserted through opening 113 of base 102 of the robot. Split connector 115 is disposed in hole 114 formed in base 102. Split connector 115 has frame 116 and housing 117. Frame 116 has five slots 116a in a row, each of which contains housing 117—five housings 117 are accommodated in frame 116. Wires 112 of internal cable are connected to each of four terminal fittings 117a; twenty wires 112 are connected to split connector 115 in all. Besides, second connector 110, which is disposed outside base 102, is removably connected to split connector 115. Second connector 110 further has a connection to external cable 107 connected to an external device. The connection relationship between external cable 107 and internal cable 108 via wires 112 and split connector 115 has a one-to-one correspondence, that is, a fixed connection.

According to the structure above, a split connector is disposed at one end of an electric cable routed through inside the manipulator. The use of the split connector allows a through-hole for passing cables to the connection case to be sized small, whereby the connection case is decreased in size. However, the signal connection between the internal cable and the external cable remains one-to-one correspondence (fixed) relation. Due to the constraint, when a

control device with built-in welding power supply as an external device is connected to the manipulator, the manipulator needs cable connections not only with the control device, but also with the power supply. This causes increase in the number of external cables connecting between the manipulator and the control device.

In a case where the control device and the welding power supply are separately connected to the manipulator, some kinds of welding feeder device mounted on the manipulator or peripheral devices including sensors require that the signal cables of the peripheral devices should be separately connected to the control device and the welding feeder device. The cables therefore require being separated at outside the manipulator.

In another case where a peripheral device, such as a sensor, is disposed close to the manipulator, the signal cable of the peripheral device needs to have an additional cable connection to a control device.

As described above, specifications in signal lines and connections largely depend on the use of the robot. The fixed signal-connection (i.e., one-to-one correspondence) between the internal cable and the external cable causes increase in the number of external cables or the need of cable separation at outside the manipulator. The inconveniency above has invited complicated routing of the external cables, has increased in space occupied by the cables, and has increased in production costs.

SUMMARY OF THE INVENTION

According to the present invention, the manipulator-type robot, which has internal cables routed through inside the manipulator so as to establish connection to external devices, contains inside connectors and outside connectors. Each of the inside connector is directly or indirectly connected to a

predetermined signal line of signal lines constituting the internal cables, while each of the outside connectors is directly or indirectly connected to a predetermined signal line of signal lines coming from outside the manipulator. With the structure above, a different connection route is obtained by a selective connection between the inside connectors and the outside connectors.

As another aspect of the present invention, the manipulator-type robot, which has internal cables routed through inside the manipulator so as to establish connection to external devices, contains first inside connectors, second inside connectors, first outside connectors, and second outside connectors. Each of the first inside connector is directly or indirectly connected to one end of a predetermined signal line of signal lines constituting the internal cables, while each of the second inside connector is directly or indirectly connected to the other end of a predetermined signal line of signal lines constituting the internal cables. On the other hand, each of the first outside connectors is directly or indirectly connected to a predetermined signal line of signal lines from a first external device. Similarly, each of the second outside connectors is directly or indirectly connected to a predetermined signal line of signal lines from a second external device. With the structure above, a different connection route is obtained by at least any one of a selective connection between first inside connectors and the first outside connectors and a selective connection between the second inside connectors and the second outside connectors.

As still another aspect of the present invention, the manipulator-type robot contains first outside connectors each of which is directly or indirectly connected to a predetermined signal line of signal lines of a first external device, and second outside connectors each of which is directly or indirectly connected to a predetermined signal line of signal lines of a second external device. With the structure above, a different connection route is obtained by a selective

connection between the first outside connectors and the second outside connectors.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a manipulator in accordance with a first exemplary embodiment of the present invention.

Fig. 2 is a perspective view of a connection case in accordance with the first exemplary embodiment.

Fig. 3 is a section view illustrating the essential part of the schematic structure of the connection case in accordance with the first exemplary embodiment.

Fig. 4 shows a wiring diagram of the interior of the connection case in accordance with the first exemplary embodiment.

Fig. 5 shows a wiring diagram of the interior of the connection case in accordance with a second exemplary embodiment.

Fig. 6 shows a wiring diagram of the interior of the connection case in accordance with a third exemplary embodiment.

Fig. 7 shows a wiring diagram of the interior of the connection case in accordance with a fourth exemplary embodiment.

Fig. 8 shows a wiring diagram of the interior of the connection case in accordance with an exemplary embodiment.

Fig. 9A is a section view illustrating the essential part of the interior of a connection case of a conventional industrial robot.

Fig. 9B is a section view illustrating the conventional split connector shown in Fig. 9A.

REFERENCE MARKS IN THE DRAWINGS

1	manipulator
2	base
3	connection case
4a, 4b	external connector
44a, 44b	internal connector
5	bulkhead union
6	signal connecting section
61, 61a, 61b	outside connector
62, 63	inside connector
64	peripheral device-side connector
7a, 7b	external cable
8	internal cable
9	motor
10	peripheral device
100, 200	external device

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(FIRST EXEMPLARY EMBODIMENT)

Fig. 1 is a perspective view of the manipulator that constitutes the industrial robot in accordance with a first exemplary embodiment of the present invention. Manipulator 1 is disposed on base 2. Connection case 3 has a connector for establishing a cable connection to an external device, such as a control device. Fig. 2 is a perspective view of connection case 3. Connection case 3 contains external connector 4a for first external device 100 (not shown), internal connector 44b for second external device 200 (not shown), and bulkhead union 5. External connector 4a establishes a cable connection to first external device 100, similarly, internal connector 44b establishes a cable

connection to second external device 200. Bulkhead union 5 is used for connecting fluid pipes that carry air or gas.

Fig. 3 is a section view illustrating the essential part of the general structure of connection case 3. First external device 100 (not shown) has a cable connection to manipulator 1 (not shown) via external cable 7a, external connector 4a, and internal connector 44a. Similarly, although Fig. 3 does not show, second external device 200 has a cable connection to manipulator 1 via external cable 7b, external connector 4b, and internal connector 44b. Internal cable 8, which contains electric cables and fluid pipes for carrying air or gas, is routed through the inside of manipulator 1. These cables and pipes above are used for the motor that drives joint axes of manipulator 1, a welding feeder device mounted on manipulator 1, and peripheral devices including sensors and handling holders. Signal connecting section 6 is responsible for signal connection in connection case 3. Connector 61 disposed on the external cable-side contains a plurality of connectors each of which is directly or indirectly connected to a signal line of external cables 7a and 7b. The "indirect connection" with the signal lines means that the signal lines are connected via a connector. Similarly, connector 62 disposed on the internal cable-side contains a plurality of connectors each of which is directly or indirectly connected to a signal line of internal cable 8. Employing connectors 61 and 62 offers a selective connection between a predetermined signal line of internal cable 8 and external connectors 4a, 4b (i.e., a predetermined signal line of external cables 7a, 7b). That is, a different connection route is obtained by selectively connecting inside connector 62 to outside connector 61 in signal connecting section 6, whereby specifications in signal lines and connections between manipulator 1 and external devices can be easily changed.

Fig. 4 shows a wiring diagram of the interior of the connection case of the

embodiment. In signal connecting section 6, inside connector 62 is selectively connected between outside connector 61a for first external device 100 and outside connector 61b for second external device 200.

According to the embodiment, the signal lines of internal cable 8 connected to outside connector 61a make a cable connection to first external device 100 (here in the diagram, a controller) via internal connector 44a, external connector 4a, and external cable 7a. On the other hand, the signal lines of internal cable 8 connected to outside connector 61b make a cable connection to second external device 200 (here in the diagram, welding power supply) via internal connector 44b, external connector 4b, and external cable 7b. Motor 9 is connected to internal connector 44a via internal cable 8.

When inside connector 62 is connected to outside connector 61b, a predetermined signal line from peripheral device 10 mounted on manipulator 1 and connected to internal cable 8 is connected to second external device 200.

When inside connector 62 is connected to outside connector 61a, a predetermined signal line from peripheral device 10 mounted on manipulator 1 is connected to first external device 100, whereby signal exchange between peripheral device 10 and first external device 100 is established.

By virtue of the structure in which internal cable 8 of manipulator 1 is selectively connected between the signal lines of external cable 7a and the signal lines of external cable 7b, peripheral device 10 is easily replaced in case of necessity. The selective connection increases the range of uses of the structure.

As outside connectors 61a, 61b and inside connector 62, a flying-type square connector may be used, and the connection change may be done manually.

(SECOND EXEMPLARY EMBODIMENT)

In the structure of the second exemplary embodiment, like parts have similar reference marks as in the structure of the first exemplary embodiment, and the detailed explanation thereof will be omitted. Fig. 5 shows a wiring diagram of the interior of connection case 3 in the embodiment. The structure differs from the structure described in the first exemplary embodiment in that first external device 100 is formed into an integrated control device containing second external device 200, such as welding power supply.

According to the structure of the second embodiment, the signal lines connected to outside connector 61a make a cable connection to first external device 100 (for example, a control device with built-in welding power supply) via internal connector 44a, external connector 4a, and external cable 7a. Motor 9 is connected to internal connector 44a via internal cable 8.

When inside connector 62 is connected to outside connector 61a, a predetermined signal line from peripheral device 10 mounted on manipulator 1 and connected to internal cable 8 is connected to first external device 100.

In the structure, second external device 200 is integrated into first external device 100, and the signal lines of first external device 100 and second external device 200 are bundled together as an external cable of first external device 100 connected to manipulator 1. This eliminates cable connections via external connector 4b (not shown). That is, connection case 3 requires no other cable but external cable 7a, thereby decreasing the number of external cables. Specifically, when connection case 3 has the structure shown in Fig. 2, the structure needs three external cables in all; two (i.e., one is as a control cable, and the other is as a power cable) external cables 7a (not shown) connecting between first external device 100 and external connector 4a, and external cable 7b (not shown) connecting between second external device 200 and internal

connector 44b. On the other hand, employing the structure of the embodiment, as shown in Fig. 5, eliminates external cable 7b(not shown) connecting between second external device 200 and internal connector 44b, thereby establishing the connection between the manipulator and the external device by only two external cables 7a. External cables are thus decreased in number. Although the embodiment introduces a structure in which two external cables 7a are used, it is not limited thereto; it will be understood that the embodiment is applicable to a structure having single external connector 4a and single external cable 7a.

Besides, the structure without external cable 7b means that internal connector 44b is also not required, which contributes to a space-saved wiring with reduced production cost. A structure in which connection case 3 contains removable internal connector 44b is also effective. In this case, internal connector 44b can be removed as required.

(THIRD EXEMPLARY EMBODIMENT)

In the structure of the third exemplary embodiment, like parts have similar reference marks as in the structure of the first exemplary embodiment, and the detailed explanation thereof will be omitted. Fig. 6 shows a wiring diagram of the interior of connection case 3 of the embodiment. The structure differs from that described in the first embodiment in that external devices are connected via connection case 3. Like the structure in the first embodiment, motor 9 is connected to internal connector 44a via internal cable 8.

According to the embodiment, when a peripheral device, such as a sensor, is disposed as second external device 200 close to manipulator 1, second external device 200 has cable connections to external connector 4b via external cable 7b. An air cylinder or a positioner can be second external device 200 (i.e.,

a peripheral device) disposed adjacent to manipulator 1.

In connection case 3, when connector 61a connected to first external device 100 is connected to connector 61b connected to second external device 200, the signal lines of second external device 200 make cable connections to first external device 100 (here in the description, a controller) via internal connector 44a, external connector 4a, and external cable 7a.

As described above, by virtue of the structure capable of establishing connections between first external device 100 and second external device 200 in connection case 3, second external device 200 disposed adjacent to manipulator 1 can make connections to first external device 100 through cable connections with connection case 3. Employing the structure eliminates a cable that directly connects second external device 200 to first external device 100 disposed away from device 200, thereby decreasing the wiring length of the external cable.

Connecting first external device 100 to second external device 200 allows first external device 100 (for example, a controller) to control second external device 200 (for example, a positioner).

(FOURTH EXEMPLARY EMBODIMENT)

In the structure of the fourth exemplary embodiment, like parts have similar reference marks as in the structures of the first through the third exemplary embodiments, and the detailed explanation thereof will be omitted. Fig. 7 shows a wiring diagram of the interior of connection case 3 of the embodiment.

In the fourth embodiment, the description is given on the following structure. Peripheral device 10 is mounted on manipulator 1. As first external device 100, a control device with built-in welding power supply is

disposed. As second external device 200, a peripheral device, such as a sensor, is disposed adjacent to manipulator 1. That is, the structure above is an all-inclusive example of the first through the third embodiments. Like in the first embodiment, motor 9 is connected to internal connector 44a via internal cable 8.

First external device 100 makes cable connections to external connector 4a via external cable 7a; similarly, second external device 200 makes cable connections to external connector 4b via external cable 7b.

In the aforementioned structure, connecting a part of inside connector 62 (i.e., a first inside connector) to a part of outside connector 61a establishes connections between first external device 100 and a predetermined signal line of peripheral device 10 mounted on manipulator 1. Signal exchange between first external device 100 and peripheral device 10 is thus obtained.

Further, connecting a part of inside connector 62 (i.e., a second inside connector) to a part of outside connector 61b establishes connections between second external device 200 and a predetermined signal line of peripheral device 10 mounted on manipulator 1. Signal exchange between second external device 200 and peripheral device 10 is thus obtained.

Still further, connecting a part of outside connector 61a to a part of outside connector 61b establishes connections between first external device 100 and second external device 200. Signal exchange between first external device 100 and second external device 200 is thus obtained.

Through the connections between outside connector 61a and the first inside connector and the connections between outside connector 61b and the second inside connector, peripheral device 10 mounted on manipulator 1, first and second external devices 100, 200 disposed adjacent to manipulator 1 establish a cable connection. The structure substantially decreases the

external cable in number and in length, and accordingly, offers simple wiring for a wide range of connections. At the same time, the structure easily realizes space- and cost-saved wiring.

Although the structure of the embodiment is described as an all-inclusive example of the first through the third embodiments, it is not limited thereto; a combination of two out of the structures in the three embodiments is also effective.

Although the first through the fourth embodiments consistently describe a structure that contains connection case 3 for connecting the signal lines therein, it is not limited thereto; the signal connecting section can be disposed inside manipulator 1, instead of connection case 3.

Throughout the four embodiments described so far, the description focuses on the external device-side connection, that is, the connection of first and second external devices 100, 200, and external cables 7a, 7b. The structure is also applicable to the connection on the side of peripheral device 10. In this case, internal cable 8 is formed so as to have both ends selectively connected between a peripheral device and an external device. For example, as shown in Fig. 8, inside connector 63 is disposed at an end of internal cable 8, and connector 64 is disposed on the side of peripheral device 10. Employing connector 63 and connector 64 allows internal cable 8 to make selective connections between peripheral device 10 and an external device. By virtue of the structure, peripheral device 10 is easily changed (or replaced). At the same time, first and second external devices 100, 200 that communicate with peripheral device 10 are also easily changed. When peripheral device 10 needs to be changed, there is no need to change internal cable 8. That is, the structure above allows a peripheral device or an external device to have selective connections without replacement of internal cable 8. It will be

understood that a structure having internal cable 8 capable of realizing the selective connection, not at both ends of the cable, but on peripheral device-side only, is also effective. In this case, too, a peripheral device is easily replaced.

INDUSTRIAL APPLICABILITY

The structure of the present invention simplifies wiring of external cables and saves the wiring space with ease and at a low cost so as to be applicable to a wide range of uses. The structure is particularly effective in a manipulator-type robot that operates in connection with an external device.